
Space Weather Technical Forecast

Issued on Thursday 14 November 2024 at 13:10 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Isolated R1/R2 radio blackouts possible. Slight chance of G1/Minor Geomagnetic Storm intervals, mainly 14 and 17 Nov.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Moderate during the past 24-hours with one isolated M-flare, an M1.7 peaking at 13/1708 UTC from AR3889.

There are now five sunspot regions on the visible disc, with AR3891 fading from view and AR3894 numbered in the north-east. AR3889, in the south-west, is by far the largest and most complex region. It consists of two main clusters of mature spots. The remaining regions are relatively small and simple.

No CMEs observed over the past 24 hours are considered to have an Earth-directed component.

Solar Wind / Geomagnetic Activity: Solar winds at L1 measured by ACE were initially indicative of a slow regime but rose steadily from approximately 14/0300UTC under the likely influence of an approaching high speed stream. Wind speeds initially around 330km/s increased to between 380-410km/s. Density initially average to below average decreased following HSS arrival. The interplanetary magnetic field (IMF), Bt, initially weak, also saw a steady increase following HSS arrival, becoming persistently moderate, with a peak around 14nT. The north-south component, Bz, mostly varied weakly, but became more moderate following HSS arrival, initially moderately positive but recently falling negative, +10/-9nT. The phi angle was positive (away from the Sun) throughout. Geomagnetic activity was Quiet to Unsettled (Kp0-3).

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 remained at background levels.

High energy electron flux (greater than 2MeV) observed by GOES16 was initially at mostly moderate levels, peaking at 617pfu at 13/1630 UTC. The associated 24-hour fluence has been on a slight upward trend, but remains below the Active threshold. The integrated flux observed at 14/0000 UTC was 1.79e7.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity expected, with a chance of M-class flares and a slight chance of X-class flares, mostly from AR3889.

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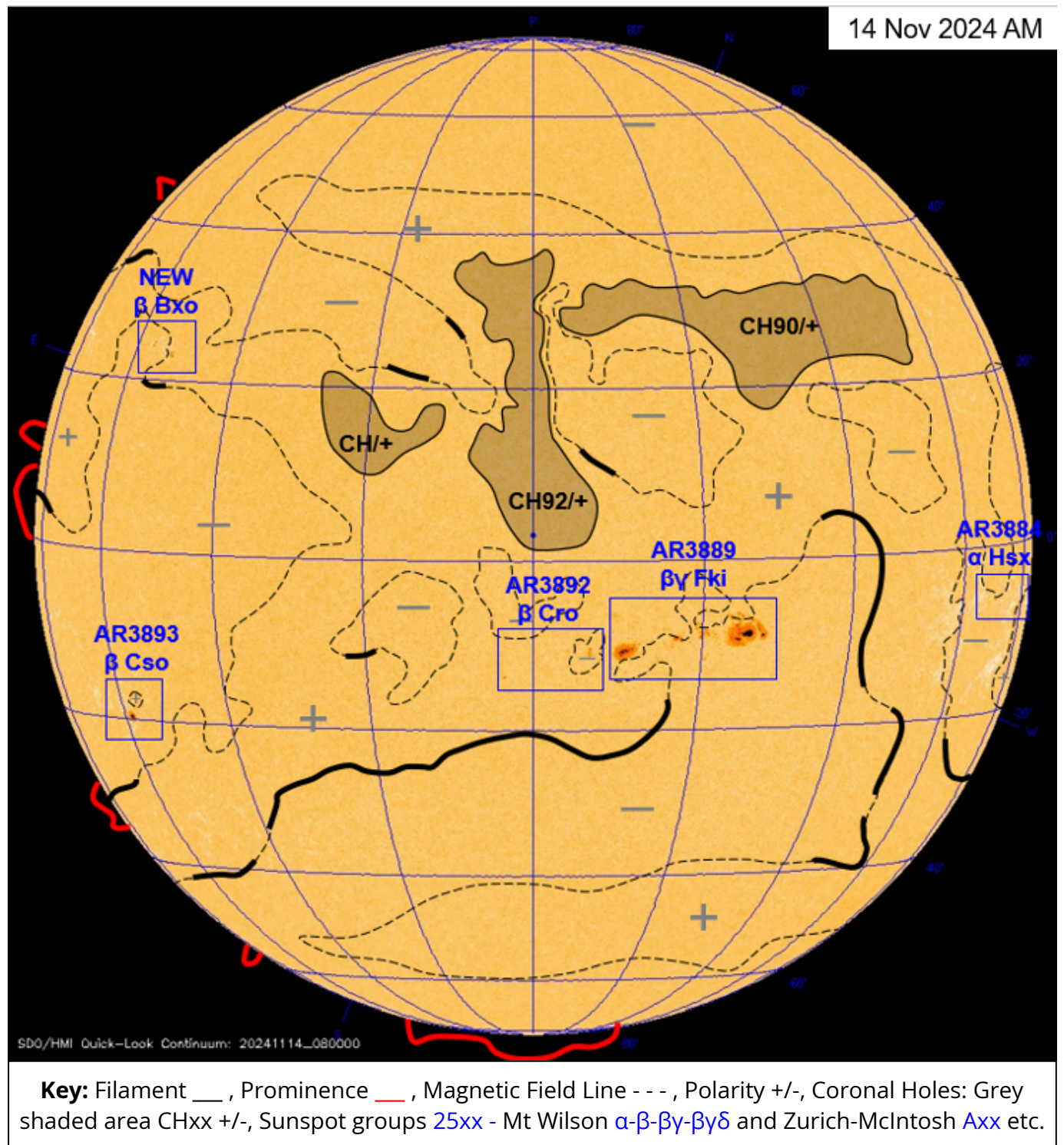
Solar Wind / Geomagnetic Activity: No Earth-directed CMEs currently feature in the forecast.

Connection to a coronal hole fast wind is ongoing Day 1 (14 Nov) with slightly elevated wind speeds which could then persist for much of the period. Geomagnetic activity is expected to be largely Quiet to Unsettled (Kp1-3). On Day 1 (14 Nov) Active (Kp4) conditions are possible with a slight chance of G1/Minor Geomagnetic Storm intervals (Kp5). During Days 2-3 there remains a very slight chance of further G1/Minor Geomagnetic Storm intervals. This risk then rising again on Day 4 (17 Nov) with a possible connection to another coronal hole fast wind.

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 is at background levels. There is a slight chance of S1/Minor solar radiation storms due to the potential for flaring from AR3889 as it rotates into a more geoeffective position in the western hemisphere.

The high energy electron flux may potentially rise to diurnal peaks at high levels during the period, with the associated fluence most likely persisting below Active levels.

Figure 1: Solar Synoptic Map Valid 14/0800 UTC.



Geomagnetic Storms

No Earth-directed CMEs currently feature in the forecast. One filament lift-off from the southern hemisphere on 11 Nov produced a CME around 11/1630 UTC which is expected to pass below Earth's orbit. However, a small number of ENLIL ensemble members suggest some glancing enhancement on Day 1 (14 Nov) attributed to this event. There are a number of filaments which have shown signs of instability and warrant monitoring for potential sources of CMEs during the period.

The four-day forecast comprises primarily of coronal hole influences. Connection to a HSS from CH90/+ is ongoing, with some element of enhancement persisting through much of the forecast period. However it may be the case that the Earth only brushes along the southern boundary of this coronal hole, with enhancements coming and going. This feature gave some limited influence on the previous rotation, with solar winds reaching around 450-500km/s, but does extend further east and slightly further south currently. MOSWOC ENLIL is not suggesting a significant connection to CH90/+, so confidence is reduced. Connection to a HSS from CH92/+ is thought likely into Day 4 (17 Nov), with this coronal hole currently crossing centre disc.

Geomagnetic activity is expected to be largely Quiet to Unsettled (Kp1-3) through the period. On Day 1 (14 Nov), Unsettled to Active (Kp3-4) conditions are possible with a slight chance of G1/Minor Geomagnetic Storm intervals (Kp5) following any more significant connection to the HSS from CH90/+. During Days 2-3 there remains a very slight chance of further G1/Minor Geomagnetic Storm intervals owing to the feature's longitudinal extent. This risk then rising again on Day 4 (17 Nov) with a possible connection to another HSS from CH92/+.

Geomagnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	20	10	10	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Radio Blackouts - X-Ray Flares

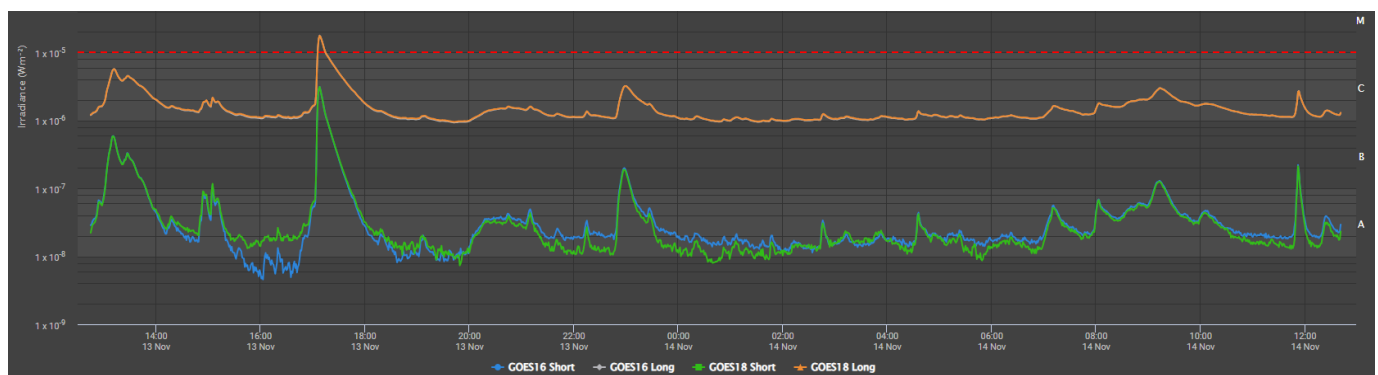
Solar activity was Moderate during the past 24 hours with one M-flare, a M1.7 flare peaking at 13/1708 UTC from AR3889.

AR3889, in the south-west, is by far the largest and most complex region and dominates the current flare risk. It consists of two main clusters of mature spots with some fading and simplification observed in the intermediate portion and a seeming reduction in activity. The threat of further flares from this region persists however, and it remains on the visible disk through the period. The remaining regions are relatively small and simple. Recurrence suggests the potential for returning region through the second half of the period, although far-side sounding data has limited strong signals.

Overall Low to Moderate activity is likely, with a chance of isolated M-flares and persistent slight chance of X-flares from AR3889 pending further developments. Any reduction in risk from apparent simplification of AR3889 into the period balanced by the potential for returning region, with a therefore steady risk.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability		(Yes/No)	(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	Yes	50	50	50	50
Very Active	R3-R5 (X Class)	No	10	10	10	10

Figure 2: Latest 24hr GOES16/18 X-Ray Flux trace.



Solar Radiation Storms (High Energy Protons)

High energy proton flux at GOES18 is at background levels and is likely to remain that way during the period in the absence of any significant flare activity.

There is a slight chance of S1/Minor Solar Radiation storms over the period, chiefly due to any potential significant flaring from AR3889 as it increasingly rotates into a more geoeffective position in the western hemisphere.

Radiation Storms	Level ($\text{cm}^{-2}\text{sr}^{-1}\text{s}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq \text{S1}$	No	15	15	15	15
Very Active	$\geq \text{S3}^*$	No	1	1	1	1
* $\text{S3} \geq 10 \text{ MeV} \geq 1000 \text{ pfu}$ and/or $50 \text{ MeV} \geq 10 \text{ pfu}$. ($\text{pfu} = \text{cm}^{-2}\text{sr}^{-1}\text{s}^{-1}$)						

High Energy Electrons ($\geq 2\text{MeV}$)

High energy electron flux (greater than 2MeV) as observed by GOES16 is at mostly moderate levels.

Persistence-wise, Earth is now approaching a period where spells of high flux are possible, with diurnal maxima reaching high levels during the last rotation of what is now CH90/+. 24-hour fluence levels are expected to remain below Active levels however, although with MOSWOC REFM perhaps a little low in its forecast fluence level.

Overall, in the absence of any CME arrivals, there is a rising slight chance of Active fluence, peaking later in the period after geomagnetic activity subsides from the onset of CH90.

GEO Electron Environment	Level ($\text{cm}^{-2}\text{sr}^{-1}\text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2\text{ MeV}$ $\geq 1\times 10^8$	No	1	5	5	5
Very Active	$\geq 2\text{ MeV}$ $\geq 1\times 10^9$	No	1	1	1	1

Figure 3: Latest MOSWOC REFM output.

